

What is claimed is:

- 1 1. An apparatus for seismic data acquisition comprising:
 - 2 a) a sensor unit for sensing seismic energy, the sensor unit providing a signal
 - 3 indicative of seismic energy sensed by the sensor unit;
 - 4 b) an acquisition device co-located with the sensor unit and coupled thereto for
 - 5 receiving the signal;
 - 6 c) a memory unit having a first memory disposed in the acquisition device for
 - 7 storing information indicative of the received signal;
 - 8 d) a second memory for storing a location parameter associated with the sensor
 - 9 unit; and
 - 10 e) a communication device for providing direct communication between the
 - 11 acquisition device and a remotely-located central controller.
- 1 2. An apparatus according to claim 1, wherein the sensor unit and the acquisition
- 2 device are housed in a common housing.
- 1 3. An apparatus according to claim 1, wherein the sensor unit and the acquisition
- 2 device are coupled together with a cable.
- 1 4. An apparatus according to claim 1, wherein the sensor unit includes one of a
- 2 velocity sensor and a pressure sensor.
- 1 5. An apparatus according to claim 1, wherein the sensor unit includes an
- 2 accelerometer.
- 1 6. An apparatus according to claim 1, wherein the sensor unit further comprises a
- 2 multi-component sensor.
- 1 7. An apparatus according to claim 1, wherein the sensor unit further comprises a

2 multi-component accelerometer having a digital output signal.

1 8. An apparatus according to claim 1 further comprising an analog-to-digital converter
2 disposed in the sensor unit, the signal provided by the sensor unit including a digital signal.

1 9. An apparatus according to claim 1, wherein the signal is an analog signal, the
2 apparatus further comprising an analog-to-digital converter disposed in the acquisition
3 device for converting the signal to digital data.

1 10. An apparatus according to claim 1, wherein the first memory further comprises a
2 nonvolatile memory.

1 11. An apparatus according to claim 1, wherein the first memory further comprises a
2 removable memory.

1 12. An apparatus according to claim 1, wherein the first memory further comprises one
2 or more of a miniature hard disk drive and a nonvolatile removable memory card.

1 13. An apparatus according to claim 1, wherein the memory unit includes an inductive
2 coupling device for transferring the information stored in the memory unit to an external
3 device.

1 14. An apparatus according to claim 1, wherein the memory unit includes an optical
2 coupling device for transferring the information stored in the memory unit to an external
3 device.

1 15. An apparatus according to claim 1, wherein the sensor unit is coupled to the
2 acquisition device using a sensor connector, the memory unit also being coupled to the
3 sensor connector for enabling retrieval of the information stored in the memory unit using
4 the sensor connector.

- 1 16. An apparatus according to claim **1**, wherein communication with the
2 remotely-located central controller provides wireless command and control for the
3 apparatus.
- 1 17. An apparatus according to claim **1** further comprising a processor associated with
2 the acquisition unit and the communication device, the processor processing programmed
3 instructions enabling a software-defined radio transceiver.
- 1 18. An apparatus according to claim **1**, wherein the communication device includes a
2 direct conversion radio transceiver for wireless communication between the apparatus and
3 the remotely-located central controller.
- 1 19. An apparatus according to claim **1** further comprising a processor in the acquisition
2 unit for providing one or more of local control, time keeping, and power management.
- 1 20. An apparatus according to claim **1** further comprising a power source disposed in
2 the acquisition device for providing electrical power to one or more of the acquisition
3 device, the sensor unit and the communication device.
- 1 21. An apparatus according to claim **20**, wherein the power source is removable.
- 1 22. An apparatus according to claim **20**, wherein the power source includes a
2 rechargeable battery.
- 1 23. An apparatus according to claim **22** further comprising an inductive coupling in the
2 acquisition device, the inductive coupling being operably coupled to the rechargeable
3 battery to allow charging of the rechargeable battery by a second power source external
4 to the acquisition device.

1 24. An apparatus according to claim **22** further comprising a connector disposed in the
2 data acquisition device, the connector being operably coupled to the rechargeable battery
3 to allow charging of the rechargeable battery by a second power source external to the
4 acquisition device.

1 25. An apparatus according to claim **22**, wherein the rechargeable battery comprises
2 one or more of a nickel-metal hydride battery, a lithium-ion battery, and a lithium-polymer
3 battery.

1 26. An apparatus according to claim **1**, further comprising a GPS receiver associated
2 with the sensor unit for determining the location parameter.

1 27. A method for for seismic data acquisition comprising:

- 2 a) sensing seismic energy in the earth using a sensor unit coupled to the earth;
- 3 b) sending a signal indicative of the sensed seismic energy from the sensor unit
4 to an acquisition device co-located with the sensor unit;
- 5 c) storing information indicative of the signal in a first memory disposed in the
6 acquisition device;
- 7 d) storing a location parameter in a second memory; and
- 8 e) directly communicating with a remotely-located central controller using a
9 communication device co-located with the sensor unit and the acquisition
10 device.

1 28. A method according to claim **27**, wherein the sensor unit is selected from one of a
2 velocity sensor and a pressure sensor.

1 29. A method according to claim **27**, wherein the sensor unit includes an accelerometer
2 and signal is indicative of a sensed acceleration of the seismic energy.

- 1 30. A method according to claim **27**, wherein the sensor unit further comprises a
2 multi-component sensor and the signal is indicative of movement in at least two directions.
- 1 31. A method according to claim **27**, wherein sending the signal includes sending a
2 digital signal from the sensor unit.
- 1 32. A method according to claim **27**, wherein sending the signal includes sending an
2 analog signal from the sensor unit, the method further comprising digitizing the analog
3 signal in the acquisition device.
- 1 33. A method according to claim **27**, wherein storing information in the memory unit
2 includes storing the information in a non-volatile memory.
- 1 34. A method according to claim **27**, wherein the memory unit further comprises a
2 removable memory, the method further comprising removing a full memory unit from the
3 acquisition device to allow replacement of the full memory unit with an empty memory unit.
- 1 35. A method according to claim **27**, wherein the memory unit includes an inductive
2 coupling device, the method further comprising transferring the information stored in the
3 memory unit to an external device using the inductive coupling device.
- 1 36. A method according to claim **27**, wherein the memory unit includes an optical
2 coupling device, the method further comprising transferring the information stored in the
3 memory unit to an external device using the optical coupling device.
- 1 37. A method according to claim **27**, wherein the sensor unit is coupled to the
2 acquisition device using a sensor connector, the memory unit also being coupled to the
3 sensor connector, the method further comprising retrieving the information stored in the
4 memory unit using the sensor connector.

1 38. A method according to claim **27**, wherein communicating with the remotely-located
2 unit includes wireless communication of command and control signals for the acquisition
3 device.

1 39. A method according to claim **27** further comprising providing one or more of local
2 control, time keeping, and power management using a processor disposed in the
3 acquisition unit.

1 40. A method according to claim **27** further comprising providing power to one or more
2 of the acquisition device, the sensor unit and the communication device using a power
3 source disposed in the acquisition device.

1 41. A method according to claim **40**, wherein the power source includes a rechargeable
2 battery, the method further comprising recharging the rechargeable battery using a second
3 power source external to the acquisition device and coupled to the acquisition device using
4 one of a connector and an inductive coupling.

1 42. A method according to claim **27** further comprising providing a time keeping function
2 using a clock circuit and processor disposed in the acquisition device.

1 43. A method according to claim **42**, wherein a seismic data acquisition session is
2 initiated by the time keeping circuit.

1 44. A method according to claim **27** further comprising providing synchronization
2 information to the acquisition device for time keeping from the remotely-located central
3 controller.

1 45. A method according to claim **27** further comprising initiating a seismic data
2 acquisition session from the remotely-located central controller.

1 46. A method according to claim **27** further comprising sending recording status
2 information from the acquisition device to the remotely-located central controller in real time
3 over a wireless communication link.

1 47. A method according to claim **27** further comprising sending the information from the
2 acquisition device to the remotely-located central controller in real time over a wireless
3 communication link.

1 48. An apparatus for detecting unwanted movement of a remotely-located seismic data
2 acquisition device, comprising:

- 3 a) a sensor disposed in the seismic data acquisition device for detecting
4 movement, the sensor providing a first signal indicative of the movement;
- 5 b) a processor coupled to the sensor for processing the first signal, the
6 processor providing a second signal indicative of unwanted movement of the
7 data acquisition device;
- 8 c) a communication device located with the sensor and the acquisition device
9 to transmit the second signal to a central controller.

1 49. An apparatus according to claim **48**, wherein the communication device is a wireless
2 communication device.

1 50. An apparatus according to claim **48**, wherein the sensor is acoustically coupled to
2 the earth to sense seismic energy in the earth, the second signal being further indicative
3 of seismic energy in the earth.

1 51. An apparatus according to claim **48** further comprising a second sensor acoustically
2 coupled to the earth to sense seismic energy in the earth, the second sensor providing a
3 third signal indicative of the sensed seismic energy.

1 52. An apparatus according to claim **51**, wherein the first signal and third signal are
2 combined and the second signal includes the combined first signal and third signal.

1 53. An apparatus according to claim **48**, wherein the sensor includes an accelerometer.

1 54. An apparatus according to claim **48**, wherein the sensor includes a multi-axis
2 accelerometer.

1 55. A method for detecting unwanted movement of a remotely-located seismic data
2 acquisition device, comprising:

- 3 a) detecting movement using a sensor disposed in the seismic data acquisition
4 device, the sensor providing a first signal indicative of the movement;
- 5 b) processing the first signal using a processor coupled to the sensor, the
6 processor providing a second signal indicative of unwanted movement of the
7 data acquisition device;
- 8 c) transmitting the second signal to a remotely-located central controller using
9 a communication device co-located with the sensor and the acquisition
10 device.

1 56. A method according to claim **55**, wherein transmitting the second signal includes
2 transmitting the second signal using a wireless communication link.

1 57. A method according to claim **55** further comprising sensing seismic energy in the
2 earth using the sensor, the second signal being further indicative of seismic energy in the
3 earth.

1 58. A method according to claim **55** further comprising sensing seismic energy in the
2 earth using a second sensor, the second sensor providing a third signal indicative of the
3 sensed seismic energy.

1 59. A method according to claim **58** further comprising combining the first signal and
2 third signal, the second signal including the combined first signal and third signal.

1 60. A method according to claim **55**, wherein detecting movement includes sensing
2 acceleration with an accelerometer having one or more axes of sensitivity.

1 61. A system for seismic surveying, comprising:

- 2 a) a central controller;
- 3 b) a sensor unit remotely located from the central controller, the sensor unit
4 coupled to the earth for sensing seismic energy in the earth and for providing
5 a signal indicative of the sensed seismic energy;
- 6 c) a recorder device co-located with the sensor unit and coupled thereto for
7 receiving the signal and for storing information indicative of the received
8 signal in a first memory disposed in the recorder device;
- 9 d) a second memory for storing a location parameter associated with the sensor
10 unit; and
- 11 e) a communication device co-located with the sensor unit and the recorder
12 device for providing direct communication with the central controller.

1 62. A system according to claim **61** further comprising an energy source for providing
2 the seismic energy in the earth.

1 63. A system according to claim **61**, wherein the communication device includes a two-
2 way wireless transceiver for wireless communication with the central controller.

1 64. An apparatus for seismic data acquisition comprising:

- 2 a) a sensor unit coupled to the earth for sensing seismic energy in the earth, the
3 sensor unit providing a signal indicative of the sensed seismic energy; and
- 4 b) a wireless seismic recorder co-located with the sensor unit and coupled

5 thereto for receiving the signal, the wireless seismic recorder including,
6 a memory unit for storing information indicative of the received signal
7 and a wireless communication device for providing direct wireless
8 communication with a remotely-located central controller; and
9 c) a second memory for storing a location parameter associated with the sensor
10 unit.

1 65. A method for seismic data acquisition comprising:
2 a) transporting a seismic sensor unit to a seismic survey location;
3 b) deploying the seismic sensor unit;
4 c) determining one or more location parameters for the sensor unit;
5 d) updating one or more system parameters based at least in part on the
6 determined location parameters; and
7 e) sensing seismic energy using the seismic sensor.

1 66. A method according to claim **65**, wherein updating the one or more system
2 parameters includes entering a system parameter at the sensor unit location.

1 67. A method according to claim **65**, wherein updating one or more system parameters
2 includes a system parameter at a central controller.

1 68. A method according to claim **65**, wherein updating one or more system parameters
2 includes automatically entering a system parameter using one or more devices in the
3 sensor unit to determine the location parameters upon activation of the sensor unit.

1 69. A system for seismic data acquisition comprising:
2 a) a central controller;
3 b) a plurality of sensors disposed to form a seismic spread having a plurality of
4 sensing locations;
5 c) a plurality recorders, each of the plurality of recorders recording seismic

6 information corresponding to a selected sensing location from the plurality
7 of sensing locations, each of the plurality of recorders being in direct
8 communication with the central controller.

1 70. An apparatus for seismic data acquisition comprising:
2 a) a plurality of sensors disposed to form a seismic spread having a plurality of
3 sensing locations; and
4 b) a plurality recorders, each of the plurality of recorders recording seismic
5 information corresponding to a selected sensing location from the plurality
6 of sensing locations.

1 71. An apparatus for seismic data acquisition comprising:
2 a) a sensor unit for sensing seismic energy, the sensor unit providing a signal
3 indicative of the sensed seismic energy;
4 b) an acquisition device co-located with the sensor unit and coupled thereto for
5 receiving the signal;
6 c) a memory unit disposed in the acquisition device for storing information
7 indicative of the received signal; and
8 d) a direct-conversion radio transceiver for providing communication between
9 the acquisition device and a remotely-located central controller.